Issues of information support for the process of scientific enterprise's management in the universities and research organizations

Leonid Mylnikov, Alexander Kalikh
Perm National Research Polytechnic University - Electrotechnical department
Komsomolsky avenue 29, 614990 Perm, Russia
E-mail: leonid@pstu.ru, kalikh@bk.ru

***Abstract* - This article describes the problem of commercializing of scientific researches in universities. Management tasks are reduced to subtasks and combined formal algorithm. The overall control problem is reduced to a set of formal subtasks combined into a single algorithm. Here the necessity of joint control of all commercialization projects as well as the use of information systems for the successful implementation of the existing commercial potential is shown.**

Keywords - innovations, management, algorithm, support, information

I. INTRODUCTION

Nowadays, a lot of attention is being paid to issues related to the so-called high-tech, scientific enterprises. Enterprises where new scientific researchers are embodied in new products and can significantly improve existing products or technologies. Sometimes, such developments may create new markets. About the most successful examples a lot of books were written (personal computer, cellular phone, television, car).

Reasons for the rise and fall of individual civilizations and the impact on these processes of new technologies are being researched by the historians (the wheel, bronze, iron, etc.).

No one have any doubt about the fact that the impact of technology on our lives is enormous, and that its sources are research teams and scientists. However, despite the fact that such an important indicator of academic performance as the number of publications worldwide annually grows, the similar increase in the number of innovations embodied in the specific product or products does not occur. Particularly low number of such realizations is carried out in universities where new research results appear.

At present, universities and research organizations have a limited number of ways to implement its developments: for sale of licenses, for implementation of applied researches on the orders of large corporations, the creation of enterprises by the university or its employees. The gap between the amount of funds received by universities for researches and earned by universities is huge. For example, it was spent $ 48,164,473,678 for the university science in the U.S. in 2009, and only $ 1,782,113,228 were received for licensing. That is only 3.7% of the money spent (The Chronicle of Higher Education 2010). And it's, despite the fact, that the U.S. is considered the most successful country in terms of earning money for university scientific research.

Customized Research, of course, brings a significant contribution to the budget of many universities. However, holders of such developments are the customers, and customers are concerned with the further promotion of the results (Prager and Omenn 1980, pp 379-384). Therefore, research organization, in this case, prevented from receiving the profit from such research and development.

Entrepreneurship today is carried out in such a way that management of the University not only doesn't prevent but also assists professors who want to create a firm(at Harvard University, for example, professors are granted for paid vacation for a period of six months). Companies that wish to purchase a license for a particular patent or know-how as a rule do not refuse.

Managing the process of commercialization is currently focused mainly on patenting of scientific developments, commercial evaluation and finding ways to commercialize it (the sale of the license or the establishment of the firm in this case the further fate developments is in the hands of entities that received them). It is believed that large companies are experienced participants in the market and would not allow for technologies not remain in demand, and new enterprises should gain the experience of entrepreneurship (by creating and bankrupting itself until they find their niche). Such a strategy of small firms is not acceptable in some countries such as Russia. Because of the legislation of many developing countries to create a new firm is often much simpler and cheaper than to close it. In addition, each research group has its own specialization and thereby creates technologies that are often competing and the university itself creates its own ob-

stacles, to make a profit producing such technology to the market in different ways.

The obvious solution to the problem of improving the process's management of earning money through the commercialization of universities is the integrated management of the process.

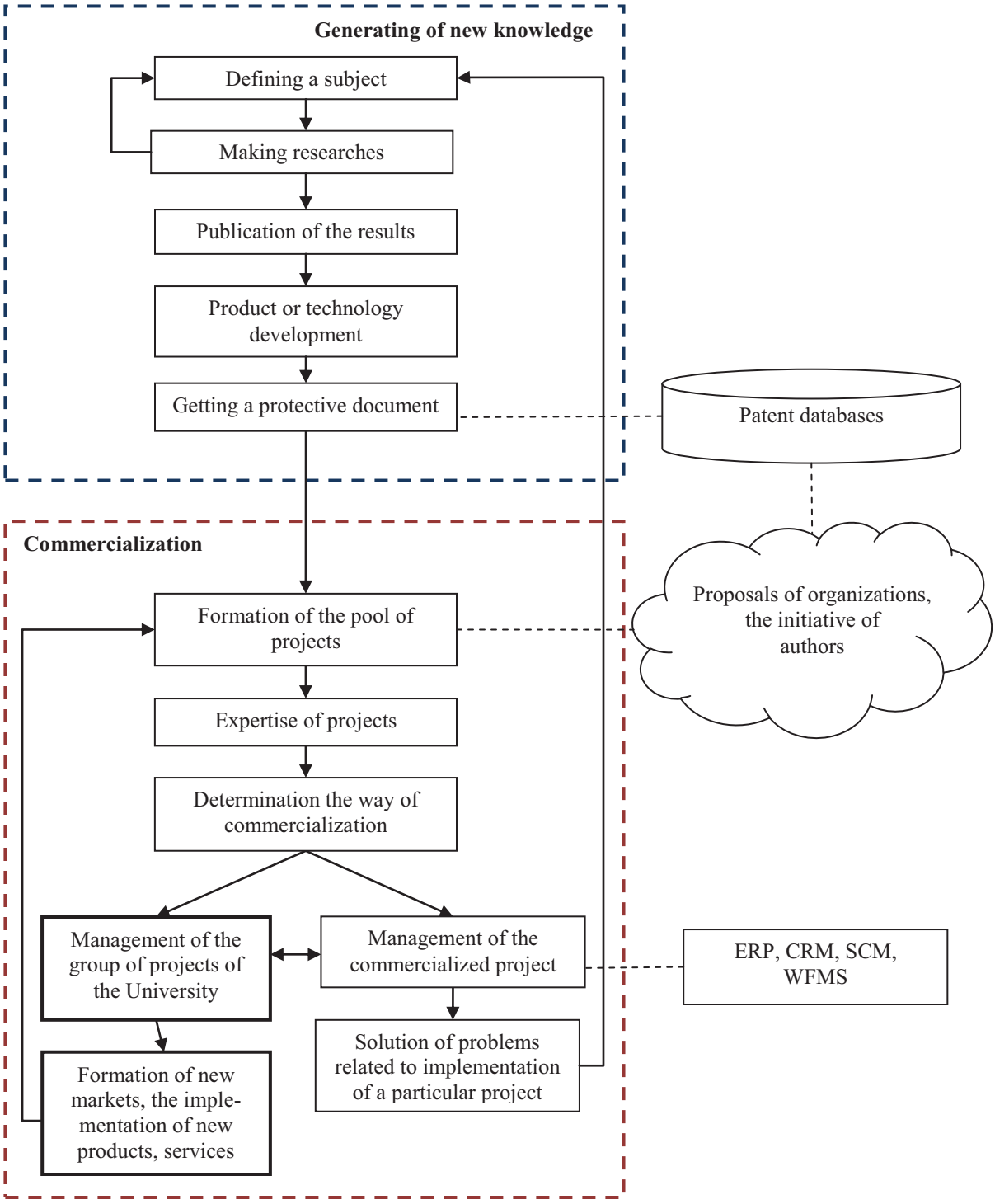

Figure 1. The system of commercialization of scientific developments from the perspective of the university as a founder of new innovative enterprises

II. STATEMENT OF PROBLEM

Management of any process based primarily on an understanding of the principles of their occurrence.

Understanding of what is happening tightly associated with the degree of formalization of process's components.

It should be understood that the management of an entire group of companies will be held as management of a single corporation (as the management of individual enterprises does not bring the desired effect). In connection with this management process will include steps which are not used in managing individual enterprises, and which currently do not have the instrumental support for their implementation (Fig. 1). Moreover most of steps in this process are so complex that their formalization is too difficult (except on qualitative level).

In addition, product-oriented processes (Stadler 2011, pp. 44-62) associated with the commercialization scientific projects, usually occur within a limited period of time and have strongly pronounced stages of development, which are limited in time (Schwarzer and Krcmar 2010). Each project comes to the stage of stabilization. For the majority of innovative projects (projects of commercialization of scientific research) the transition to this stage does not make substantial profits or may even be not profitable. In addition stable income-generating project no longer requires special attention because it is not confronted with problems that arise during the initial stages of commercialization. Therefore, commercialization of researches is described within the project approach. This greatly increases the responsibility for the quality of decisions.

Information systems of management are widely used now in order to increase the objectivity of decision-making during the management process. For their application it is necessary to: create directories of control parameters, the classification of processes and phenomena which occur in the management, standardization of management processes, the development of decision-making algorithms , the study methodological aspects of management, definition of decision points.

III. THE SUPPORT OF MANAGEMENT PROCESSES

Information support in solving problems of management of innovative projects is primarily focused at supporting of decision-making.

If the generation of knowledge refers in part to the creativity, a part associated with the commercialization may well be formalized. In our context, the approach to the formalization can be considered from two perspectives: the position of existing algorithms and information systems and the positions of structuring and convenient representation of the subject area to the person who will make a decision.

A part relating to production and registration can use existing algorithms and information systems.

However, parts related to the examination and selection methods of commercialization require more detailed consideration. This is primarily due to the fact that there is no universal algorithm that can be applied. Typically, such decisions are based on the experience of the person that makes decisions and on emerging trends. Therefore, above all, structured information and methodological ways to inform decision-making are required for their acceptance.

For accepting of such decisions in case if statistics had been accumulated, graphs with the vertical axis (Müller 2011, pp. 26-29) are often used. Thus, the principle of accumulation of information and identifying key for the success of the project values or ranges of values can be implemented (Figure 2, Tab. 1.).

Thus, as shown the structuring of information, even in small quantities allows you to emphasize, if not the corridors of values, which often lead to a result, then values which often lead to failure. For example, Fig. 2., shows that the chances of success falls down with the assistance of a second university or research organization, with the use of certificates of registration of computer programs and databases with estimates of the cost of > 30 thousand rubles. (Especially in IT).

Determination of the way of commercialization does not end when it is decided to sell the license or to establish the company, and the form of ownership is defined. The important thing is the positioning of a potential product in the market. It is here to show the "corporate" in the management process. It should take into account the effects of other projects, which realizes the university, and to find a niche in this situation. So-called portfolio matrix may be used here (Tab 2). It defines four possible structural concepts for the development of innovative trends or a separate product.

The first concept, which is reflected in the matrix, describes the behavior of the company relatively to the developed products, implemented in existing markets. The innovative enterprises' behavior in this situation should be directed to the intensification of use of existing market’s possibilities by positioning of already known products on them. That means to ensure the competitiveness of products in the markets. If the product is in its characteristics do not appear perspective then the innovative position of the enterprise may be manifested in means of removing it from the market in order to open a niche for a new innovative product.

The second concept describes the behavior of the enterprise concerning promotion of the developed products to new markets. This is due to innovative activity aimed at finding of new ways of application or on searching for ways of using an existing product. This concept requires a research to create a new consumer product with the properties that take into account the requirements of new markets and the corresponding variations in the production program. Innovations in this case realized in the form of researches and developments, expanding the scope of influence of the product, invention or technology.

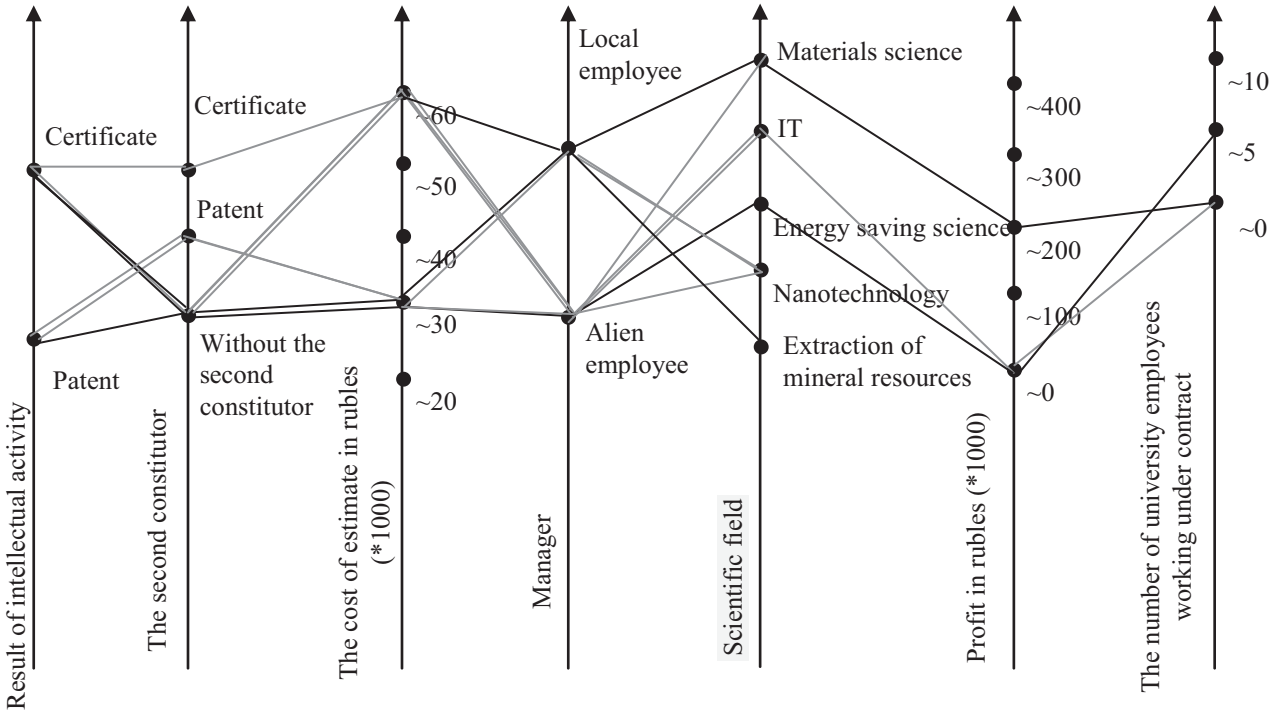

Figure 2. Graph with the vertical axis with indicators of companies created with the participation of Perm National Research University for 2010-2011 (companies, which activities are considered to be successful are marked with dark color)

The development of research and development to create new competitive product modification is the main direction of innovation enterprises in this situation. Here we speak about a work aimed at creating and developing new products or the modifications of the old products, which would have new consumer properties. Activities implement in the form of applied research and development, expanding the scope of the product, inventions or technologies.

The fourth concept (and the most productive) is associated with the creation of a new product and promoting it to the new markets. This innovative policy of the company is called diversification, i.e., expansion of research or production profile of the enterprise through the creation and development of production quality of new products and new markets for its implementation. This is the most difficult, risky and most promising concept of innovation development of capacity-building success.

This formulation of the problem determines gaps in the commercialization strategy, identifies the missing elements for a successful project, and moves from consideration of individual projects to managing a group of projects within the framework of existing models of managing. For example, group of algorithms called Slope One (Lemire and Maclachlan 2005) - for finding joint product niches, product planning algorithms (Mylnikov 2011) - for control of production resources and formation of a portfolio of projects; prediction algorithms (Mylnikov and Alkdirou 2009, pp. 293-307; Amberg and Mylnikov 2009, pp. 11-15) - to identify the most promising projects. Thus, the problem of co-management of firms comes to the problem having the mathematical formalization, and it means that here may be an algorithm which implements the principles of university management by knowledge-intensive firms (Fig. 4).

Table 1. Statistical information about the firms founded with participation of National Research Perm Polytechnic University (Russia) in 2010-2011.

Name	Result of intellectual activity	The second founder the university or institute of RAS	The cost of estimate (rub.)	Manager (staff member of the University or not)	Scientific field	Number of employees within a year after the	Amount of profit one year after establishment (thou-	Number of university staff engaged under contracts
Economic society 1	Patent	-	25 150,98	Local	nanotechnology	1	250	-
Economic society 2	Certificate	-	55 800	Alien	Information technologies	1	-	-
Economic society 3	Certificate	-	25 000	Alien	Energy saving science	4	-	4
Economic society 4	Patent	-	56 220	Alien	Information technologies	-	-	-
Economic society 5	Patent	-	25 000	Alien	Nanotechnology	-	-	-
Economic society 6	Certificate	Certificate	56 220	Alien	Nanotechnology	-	-	-
Economic society 7	Patent	Patent	25 000	Alien	Nanotechnology	-	-	-
Economic society 8	Certificate	-	54 300	Local	Extraction of mineral resources	-	-	-
Economic society 9	Patent	Patent	25 000	Local	Nanotechnology	-	-	-

The disadvantage of this approach is the fact that in the management of existing firms (such as implementing a new project through them),it must be considered the current situation within them. Each company will have its own strengths and weaknesses, which can be identified by the use of PERT or a SWOT analysis. Thus, when the strategy of implement innovative projects is developing, the internal characteristics of organizations will be considered (Utterback 1974, pp. 620-626).

The University can be considered as a management company (like the venture capital), and the formalization of the process management allows you to do tasks of developing information systems of administrative activity automation. Thus to approach to the problems of standardization of management in the given subject domain. As a result, we can expect that the percentage of applied research projects which have reached the implementation phase, as an innovative projects, will increase as well (currently only 10-15% of such projects reach the stage of commercialization).

Table 2. Product-market matrix of an innovative portfolio (Mylnikov 2009)

Products/ Markets	Existing markets	New markets
Existing products	The intensification of the markets: - Positioning of the product - Reservation of a market niche	The development of markets: - Variations of products - applied researches
New products	Product development: - Research and development - Modification of of products	Diversification

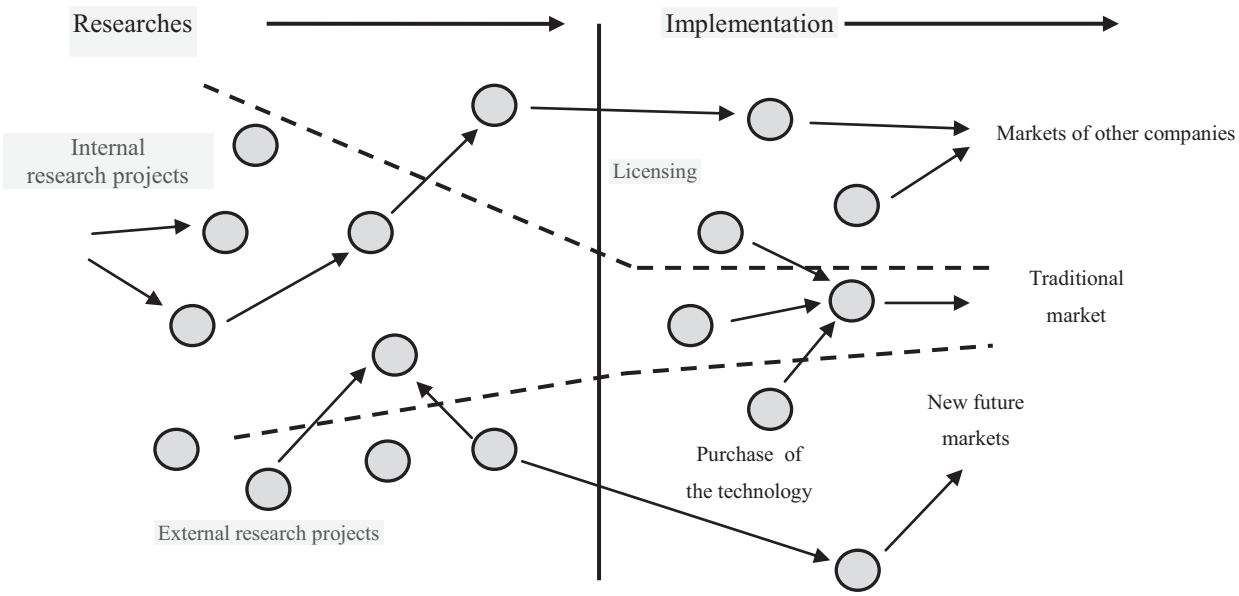

Figure 3. The paradigm of open innovation (Schwarzer and Krcmar 2010)

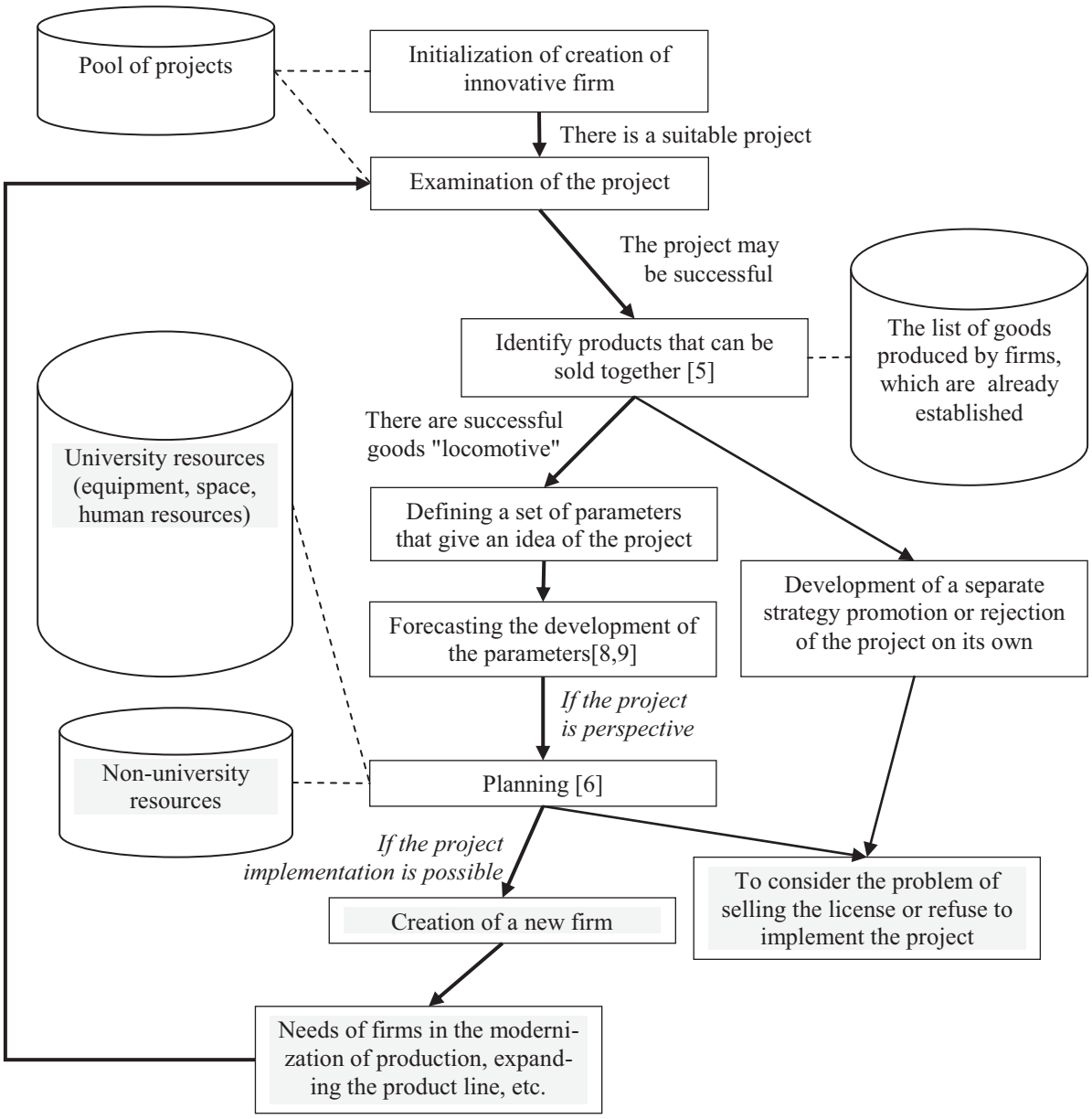

Figure 4. Algorithm for the coordination of existing innovative enterprises and creation of new, with the participation of universities or research institutions

IV. Management Information System

As follows, the information system must combine elements of analytical processing and data mining, methods for solving mathematical programming problems, must allow to make the data manipulation algorithms, allow to construct and simulate business processes, to be integrated with the DBMS.. If you look at information systems which are currently on the market (Figure 5), it becomes clear that there are currently no systems that combine all the elements. The use of large, scalable systems (which also does not satisfy all the requirements) is connected with great expenditures on buying, modification, staff. If we consider further and go directly to the level of production management problems then when going to the introduction of innovative projects, problems of Industrial Engineering arise (e.g., task management and production planning) (Mylnikov and Trusov 2011, pp. 208-213).

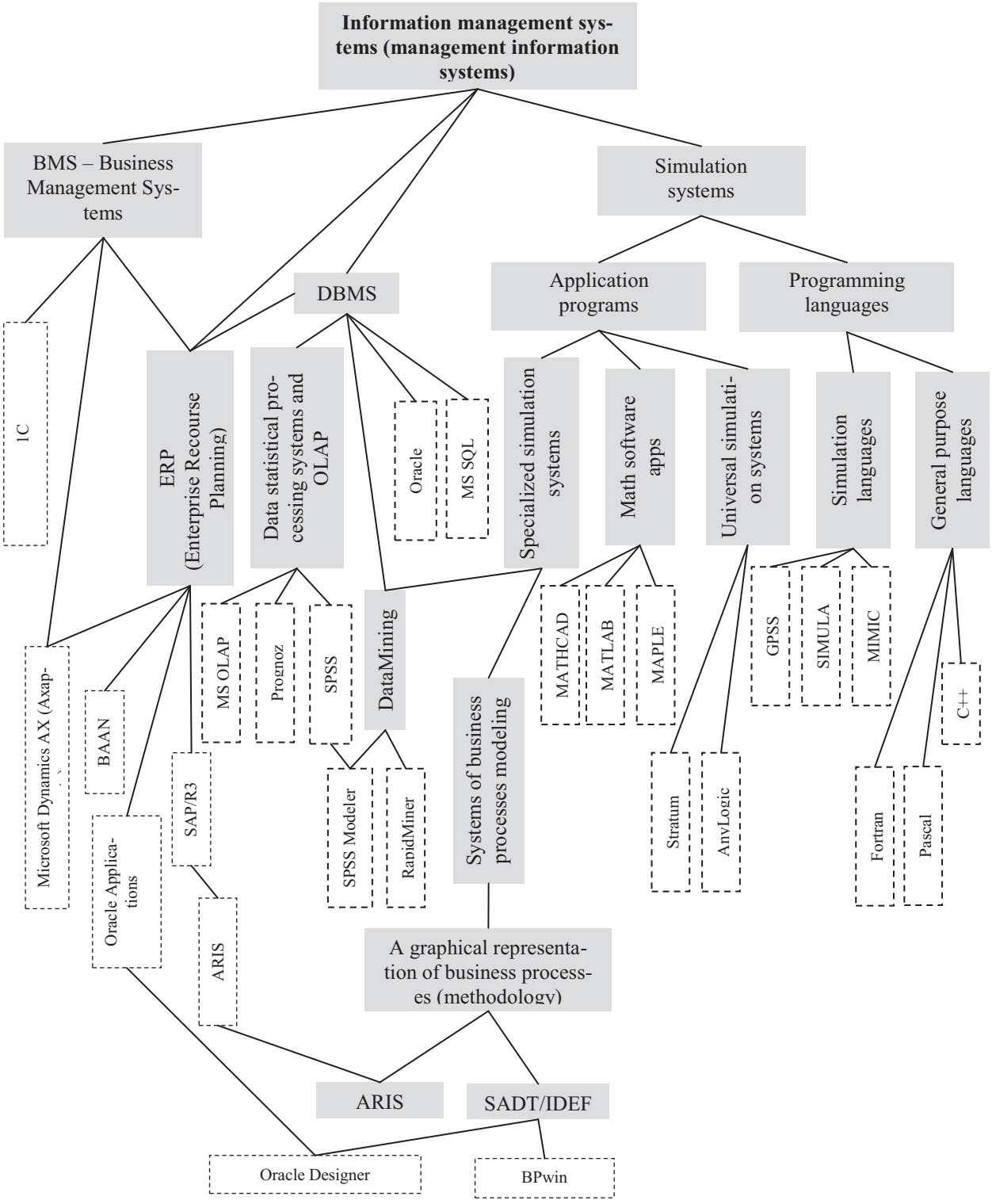

Figure 5. Approximate classification of information packets for classes of systems, the use of which is necessary for the management of enterprises according to the algorithm on Fig. 4 (gray color indicates the classes of systems, application packages and programs are marked with dots)

Adequate management can be done when it is possible to combine the two data sources: the model and data, taken from the controlled object (Shi 1987, pp. 22-29). For an adequate management of the innovative project it is required to combine together various information resources. It requires a methodical elaboration of joint use of a number of specialized IT solutions. Thus, the algorithm of coordination of implemented innovative projects can be the basis for creating a unified information system integrating software tools to support the functional stages of the innovation project. However as to create a new information system, or to integrate into a unified information space a set of information systems it should be a single information space, which can be implemented using a single bank of data (to work with this bank of data directly or through intermediate data, all subsystems should be configured . Creation of a single data bank requires the formalization of the stored information in it (in a suitable form for analysis).

V. CONCLUSION

The use of formal methods and information systems in management will help to minimize errors in decision-making, as well as develop the necessary administrative decisions, based on experience and domain knowledge. However, not all processes currently studied sufficiently. Not all processes can be adequately formalized. Key decisions will still be done by the man. Moreover, making an administrative decision, if it is based on analysis of all facts necessary for this task, does not become less complicated than the research itself results of which are planned to be commercialize. Therefore, this research itself requires additional research, the results of which can also be implemented in the form of an innovative project - management information system of innovations.

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